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(54) **Stone sawing machine.**

(57) The present invention concerns an alternative machine for cutting stone blocks with a laminated diamond tool, in which the cutting is done vertically during the descendent stroke, the inverse stroke movement being passive for the cutting.

Besides, the support structure of the diamond blades is compensated statically by another structure having the same mass which can be passive or active to cut if it bears or not a diamond tool and which describes a parallel movement to the first one but with a phase difference of half cycle.

The present machine is useful to cut ornamental stones.

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INVENTION DESCRIPTION

- A - BACKGROUND OF THE INVENTION
- B - WORKING PRINCIPLE
- 5 C - BRIEF DESCRIPTION OF THE EQUIPMENT
- D - FINAL CONSIDERATIONS

A - BACKGROUND OF THE INVENTION

10 Traditionally, the linear cutting of stone blocks is done using 2 distinct tools which can be classified into 2 groups:

- a) Diamond tools, used actually in the cutting of the smoothest stones, such as marble and similar ones, consisting of a series of diamond segments joined by soldering to steel blades adapted to a rectangular structure usually called "frame" to which an alternative linear movement is transmitted.
- 15 b) Tools without diamond, used in the cutting of the hardest stones, such as granite and similar ones, which cut by abrasive cutting and do not dispense the introduction of steel granules between the tool and the stone.

In conformity to the above mentioned diamond tools, these blades are adapted to a "frame" to which an alternative linear movement is transmitted.

20 These two processes have as a common situation the fact that both the strokes of the alternative cycle are useful for cutting.

In the known cases, the "frame" movement is made on a horizontal, vertical or oblique plane and is transmitted through mechanisms of rod - crank type but without compensation of the mass in alternative movement.

25 The object of this invention is to provide a machine for cutting hard stones with diamond tools having a vertical alternative linear movement, only the descending stroke of which being useful.

The machine accomplishes the presupposition that every working parameter inherent to the cut may be varied in function of the stone nature to be cut, block dimensions and thickness of the sections to be obtained.

30 **B - WORKING PRINCIPLE**

It was considered that the adequate methodology to attain the above mentioned aims passes through the vertical cut of the stone block along its length.

35 The cutting device comprises a set of steel blades having a constant rectangular cross - section, one of the longitudinal edges of which having diamond cutting segments with a convenient shape and spacing, each assembled to the other parallelly and removably fixed to a vertical structure, which is called "frame", to which an alternative linear movement is transmitted.

40 The cutting is carried out only during the strokes from up to down of the "frame". Therefore, the frame in addition to the vertical movement has also a transversal movement which permits the approximation of the blades set to the block during the stroke from up to down and its backward movement during the inverse strokes.

The cutting advance is obtained by the horizontal movement of the stone block against the "frame".

45 **C - BRIEF DESCRIPTION OF THE EQUIPMENT**

The machine to cut stone blocks with diamond tools is totally built of steel and comprises mainly two units:

- C.1. Structure for the stone block support and movement;
- 50 C.2. Cutting assembly unit.

C.1. STRUCTURE FOR THE STONE BLOCK SUPPORT AND MOVEMENT (It comprises):

- C.1.1. The structure for the whole stone block support and movement which is anchored in the ground, being arranged frontally and before the "frame". It contains the system for the block approximation.
- 55 C.1.2. Structure for the block reception after being cut which is arranged vertically after the "frame". It is susceptible of longitudinal movement and is used to receive and move the cutted sections of the block.

C.2. CUTTING ASSEMBLY UNIT (It comprises):

C.2.1. Fixed structure of closed ring portico type anchored in the ground and useful for supporting and guiding the movable structure.

C.2.2. Movable structure which is made of the three next assemblages:

5 C.2.2.1. Structure called "rocking lever". It is a closed ring structure in a horizontal position, pivotable approximately in the middle according to the transversal direction which receives an alternative movement received from a double motion mechanism of rod - crank type driven by an electro - hydraulic system.

10 C.2.2.2. Structure called "frame". It is the structure already referred having the shape of a closed ring, upperly pivotably linked to the "rocking - lever" by means of an axle parallel to the axle defined by the articulation of this and having a vertical guiding solidarized with 2 columns to the portico as defined under C.2.1. The "frame", as already referred, is the support for the diamond blades which are the cutting tools and simultaneously acts as the longitudinal stretching device of the blades.

15 C.2.2.3. Statical compensating structure of mass, called "counterweight". It is a structure pivoted to the "rocking lever" on a parallel axle defined by the pivotable axle of this and in opposition to the "frame". It has a vertical guiding solidarized by 2 columns to the portico as defined under C.2.1.

D - FINAL CONSIDERATIONS

20 Besides the functional scheme of the itself machine which we think is new in this kind of equipment, it is important to point out that it is the cutting principle in the vertical direction and only during the descending stroke which deserves a special attention, because besides its innovative character, it allowed to obtain very encouraging results concerning the speed and economy of the cutting operation as the 25 already done test runs have shown.

Claims

30 1. A granite and/or similar stone blocks sawing machine having a diamonded tool with reciprocating vertical movement, being useful for the cutting only the descending stroke, which comprises a statically balanced supporting structure for the cutting tool by means of another non - cutting structure with the same weight having parallel movement to the first one, both being articulated on a common structure (crankshaft) which causes a difference of phase of 180 degrees, characterized by the fact that the vertical structure is comprised by two metallic rectangular shaped frame structures, one being contained in the other.

35 2. The sawing machine according to claim 1, characterized by the fact that the assembly made by both exterior and interior frames has an alternative vertical movement whereas the interior frame has an independent movement perpendicular to the vertical movement of the assembly.

40 3. The sawing machine according to anyone of claims 1 and 2, characterized by the fact that the interior frame is supported on the exterior frame by means of several linear bearings, each of which also support two linear single acting hydraulic actuators which oppose each other and position the interior frame relative to the exterior frame in the horizontal movement.

45 4. The sawing machine according to anyone of claims 1 to 3, characterized by the fact that the driving system of the interior frame relative to the exterior frame is a hydraulic system generating a pressurized flow of a hydraulic fluid which causes the simultaneous extension and retraction of each pair of the opposing single acting hydraulic actuators.

50 5. The sawing machine according to anyone of claims 1 to 4, characterized by the fact that the hydraulic system which drives the interior frame relative to the exterior frame is driven by the crankshaft which causes the alternating movement of the frames and comprises
55 a) two linear hydraulic actuators working as alternative pumps each driven simultaneously by said crankshaft and each having equal volumes;
b) an electrically actuated bypass valve which is opened only for the starting up and shutting down procedures to interrupt cutting;

c) two hydraulic fluid accumulators, the maximum volume of each being equal to the total volume of the corresponding linear hydraulic actuators at maximum stroke for a preset regulated pressure;

5 d) a flow regulator which connects both volumes of said two hydraulic actuators according to a) so as to regulate the corresponding hydraulic fluid flow;

e) some pressure regulators which limit the maximum fluid pressure delivered to said hydraulic actuators and return the excess fluid to a storage tank;

10 f) said two linear hydraulic actuators as described above in claim 3, each of which are provided with a mechanical stop;

g) two unidirectional control valves which allow that the hydraulic fluid pump (i) to pressurize the hydraulic circuit at a preset pressure;

15 h) a pressure relief valve which assures a supply of hydraulic fluid at a preset pressure and prevents an excessive pressure; and

i) a hydraulic pump for pressurizing the hydraulic circuit at a preset pressure.

20 6. The sawing machine according to anyone of claims 1 to 5, characterized by the fact that said linear hydraulic actuators as described at claim 5. a) are provided with an angular position adjustment relative to the centerline of the crankshaft support bearings.

25 7. The sawing machine according to anyone of claims 1 to 6, characterized by the fact that the advance of the granite block toward the cutting tools is discontinuous and occurs only during the upstroke of said exterior and interior frame assembly, at which time the inner frame is in a retracted position.

8. The sawing machine according to anyone of claims 1 to 7, characterized by the fact that the pressure required to cut the granite block is applied hydraulically at a constant, regulated, adjustable rate during the cutting stroke.

25 9. The sawing machine according to anyone of claims 1 to 8, characterized by the fact that the blade construction is arranged in segment groupings which consist of an even number of segments and an uneven number of spaces which is one less than the number of segments.

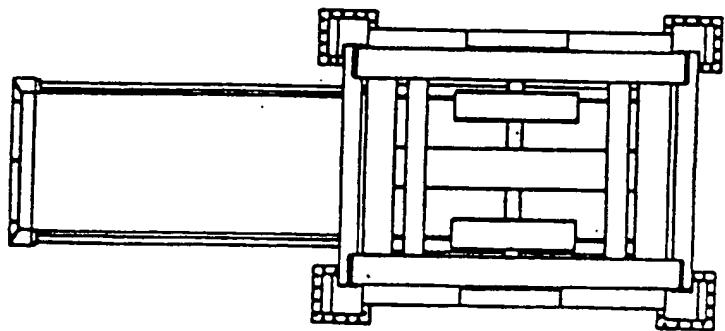
30 10. The sawing machine according to anyone of claims 1 to 8, characterized by the fact that the diamonded tool segments are installed on each blade according to the following relationship:

35	Stroke length of blade(s)	$S = 155 \text{ mm}$
	Individual segment length	$1 = 20 \text{ mm}$
	Individual space length	$v = 25 \text{ mm}$
	Space between segment groups	$V_1 = 60 \text{ mm}$
	Number of segments per group	$N = 4$
40	Number of spaces per group	$n = 3$
	Total length of segments per group	$L = N \times 1 = 80 \text{ mm}$
	Total length of internal spaces per group	$V = n \times v = 75 \text{ mm}$
	Total length of spaces per group	$V_2 = V_1 + V = 135 \text{ mm}$
	Total length of the segment group	$G = L + V = 155 \text{ mm}$

45 11. The sawing machine according to anyone of claims 1 to 10, characterized by the fact that the vicinal segments are mounted offset to the centerline of the blade.

50 12. The sawing machine according to anyone of claims 1 to 11, characterized by the fact that the major surface of each vicinal segment is at same level of the major surface of the blade.

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EUROPEAN SEARCH REPORT

Application Number

EP 91 31 0072

DOCUMENTS CONSIDERED TO BE RELEVANT															
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 5)												
E	PT-A- 93 025 (P.A. LUIS) * Whole document * & BR-A-9 003 763 ---	1-3	B 28 D 1/06 B 28 D 1/12 B 27 B 3/12												
Y	DE-A-3 004 662 (H.W. BEITZER) * Page 3, lines 1-10,25-32; claims 1,2; figures 1,2 *	1,2													
Y	WO-A-8 604 295 (OFFICINA B M S.N.C.) * Page 2, lines 30-34; page 2, line 39 - page 3, line 8; page 3, lines 25-38; claim 3; figures 1,2,4,5 *	1,2													
A	PATENT ABSTRACTS OF JAPAN, vol. 13, no. 76 (M-800), 21st February 1989; & JP-A-63 274 508 (NOMURA SEISAKUSHO K.K.) 11-11-1988 * Abstract * & JP-A-63 274 508 ---	1													
A	SOVIET INVENTIONS ILLUSTRATED, section PQ, week 8832, 21st September 1988, class P64, AN=88-226370/32, Derwent Publications Ltd, London, GB; & SU-A-1368 184 (V.P. KOTOV) 23-01-1988 * Abstract *	3,8	TECHNICAL FIELDS SEARCHED (Int. Cl.5)												
A	US-A-1 725 495 (C.W. VOGLER) * Page 1, lines 60-83; figure 1 *	7	B 28 D B 27 B												
<p>The present search report has been drawn up for all claims.</p> <table border="1"> <tr> <td>Place of search THE HAGUE</td> <td>Date of completion of the search 10-07-1992</td> <td>Examiner LILIMPAKIS E.</td> </tr> <tr> <td colspan="3">CATEGORY OF CITED DOCUMENTS</td> </tr> <tr> <td colspan="3"> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document </td> </tr> <tr> <td colspan="3"> T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document </td> </tr> </table>				Place of search THE HAGUE	Date of completion of the search 10-07-1992	Examiner LILIMPAKIS E.	CATEGORY OF CITED DOCUMENTS			X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document		
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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.
- Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claims:
- No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions.

namely:

See sheet -B-

- All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims.

namely claims 1-3, 7, 8



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LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims 1-3, 7,8
2. Claims 4-6
3. Claims 9-12

Searched claims: 1-3,7,8.

Construction of the stone sawing machine with counterweight and principal for moving the cutting frame (tool) in an orbital path by an hydraulic system. The bloc to be sawn is moved towards the tool in discontinuous manner and only during the upstroke (no cutting action) of the tools.

Claims 4-6.

Detail description of the hydraulic system claimed.

Claims 9-12.

Constructional and dimensional characteristics of the saw blade used for a sawing machine.